

Alaska Department of Environmental Conservation

Pathogens Listing Methodology



Executive Summary

The purpose of this document is to provide guidance to Alaska Department of Environmental Conservation (DEC) staff in their analysis of water quality data for the presence of pathogens for the Alaska Integrated Water Quality Monitoring and Assessment Report (Integrated Report) under Clean Water Act sections 303(d) and 305(b). This guidance defines minimum data requirements and data evaluation methods used to complete waterbody impairment or attainment determinations to satisfy Integrated Report reporting requirements.

This guidance employs a two-step process. DEC first considers minimum data qualification requirements to determine which data use is appropriate and determines if data is screening or assessment level¹. Screening level data will not be used for decision making. Secondly, if data meets minimum data qualifications to be considered assessment level, DEC evaluates data to make an attainment or impairment determination². Data evaluation should yield transparent and reproducible recommendations based on clear numeric thresholds, allowing decisions to be largely data driven.

Waterbodies are assigned to one of five possible categories based on the methodology described in this guidance. The results of the evaluation will determine whether a waterbody is impaired (Categories 5 and 4), if there is not enough information to make a determination (i.e., screening level data only) (Category 3) or considered to be attaining (Categories 1 or 2) (Table 1).

Table 1. Category definitions

Category	Description
5	Data meets minimum data requirements and waterbody is determined to be impaired. Also known as 303(d) impaired or “listed” waters.
4	Data meets minimum data requirements and waterbody is determined to be impaired, but has an approved recovery plan in place.
3	There is not enough data to make an attainment or impairment determination.
1 & 2	Data meets minimum data requirements and indicates that water quality standards are attained for all or some of the designated uses.

¹ Alaska Department of Environmental Conservation. 2020. Alaska Consolidated Assessment and Listing Methodology.

² Data evaluations are made by first applying the most stringent criteria to determine attainment or impairment. If the most stringent criteria is exceeded, and impairment is determined, data will subsequently be evaluated against all other uses.

Parameter Specific Criteria

The pathogens (bacteria) criteria for freshwater and marine water uses are specified in Alaska's Water Quality Standards 18 AAC 70.020(2) and (14). The criteria are summarized in Tables 2 and 3. DEC conducts water quality assessments using the most stringent of fresh and marine water criteria as such criteria would be protective of all designated and existing uses.

Table 2. Water quality criteria for marine and freshwater water supply and recreation uses

Designated Use	Freshwater Criteria	Marine Criteria
(A) Water Supply (i) drinking, culinary, and food processing ³	In a 30-day period, the geometric mean may not exceed 20 fecal coliform colony forming units (cfu)/100 ml, and not more than 10% of the samples may exceed 40 fecal coliform cfu/100 ml. ⁴	In a 30-day period, the geometric mean of samples may not exceed 20 fecal coliform cfu/100 ml, and not more than 10% of the samples may exceed 40 fecal coliform cfu/100 ml.
(B) Water Recreation (i) contact recreation	In a 30-day period, the geometric mean of samples may not exceed 126 <i>Escherichia coli</i> (<i>E. coli</i>) cfu/100ml, and not more than 10% of the samples may exceed a statistical threshold value of 410 <i>E. coli</i> cfu/100 ml.	In a 30-day period, the geometric mean of samples may not exceed 35 enterococci cfu/100 ml, and not more than 10% of the samples may exceed a statistical threshold value of 130 enterococci cfu/100 ml.

Table 3. Water quality criteria for marine waters (shellfish harvest)

Designated Use	Marine Criteria
(D) Harvesting for Consumption of Raw Mollusks or Other Raw Aquatic Life	The geometric mean of samples may not exceed 14 fecal coliform cfu/100ml; and not more than 10% of the samples may exceed: 43 mpn ⁵ /100ml for a five-tube decimal dilution test 49 mpn /100ml for a three-tube decimal dilution test 28 mpn/100ml for a twelve-tube single dilution test 31 cfu/100ml for a membrane filtration test

³ The applicable use for assessing marine waters is 18 AAC 70.010(b)(14)(A) Water Supply (ii) seafood processing

⁴ WQS Language pertaining to groundwater at 18 AAC 70.020(b)(2) has been removed from this table as it is not directly applicable to this policy.

⁵ Most Probable Number (MPN): the statistic that represents the number of individuals most likely present in a given sample, based on test data.

Water Quality Data Qualification

In order for data to be considered for impairment or attainment decisions, a quality assurance project plan (or acceptable alternative) and the appropriate metadata must be submitted including:

- Waterbody name and location
- Sampling location identifiers including latitude/longitude
- Date and time each sample was collected
- Type of sample
- Parameters analyzed and analytical methods
- Quality Assurance/Quality Control data and any data qualifiers
- Standard operating procedures used (for example data rejection procedures)
- Environmental conditions

Laboratory data reports, chain of custody forms, and calibration records should be available upon request. Non direct measurements such as photos, weather conditions and waterbody conditions may be requested as supporting documentation for establishing the data quality.

Bacteria levels may be affected by environmental conditions; therefore, the assessment period should be representative of both ambient and adverse (for example stormwater event) pollution conditions. Environmental factors such as seasonal temperature conditions, high flow conditions or a combination of should be considered during sample collection.

DEC may also define a specified critical period or season in which the criteria need to be met, based on water temperatures and seasonal water use patterns. This time period is typically defined in the quality assurance project plan or sampling and assessment plan, and may bracket specific months or seasons in which bacteria levels are more prone to exceed criteria. Where a critical period applies, DEC will assess bacteria for the critical period as well as any additional data collected during that water year.

Minimum Data Requirements

A minimum number of bacteria samples must be collected in two of the most recent 5 years for an attainment or impairment determination. Data will be grouped and evaluated by individual water year, which extends from October 1 of one year through September 30 of the following year. Water years do not need to be consecutive for assessment purposes. If fewer samples are collected, data is only considered for screening purposes¹ and the waterbody will be placed in Category 3. Screening data is considered informational only and insufficient to make an attainment or impairment determination.

For freshwater and marine water supply and contact recreation uses, a minimum of five samples within a 30-day sampling period are required. Sample collection should be distributed over the 30-day period. Two or more samples may be taken on the same day but should not be taken at the same sampling location to increase spatial coverage. Data sets must have at least one distinct 30-day sampling interval for each water year to be used for assessment purposes.

For the marine harvest use, 15 samples are required in the first year and 5 samples are required within the second year.⁶ Two water years of data may be combined to meet a 20-sample minimum for the purposes of analysis but the results would equate to a single year exceedance.⁷ Data sets that do not have at least two distinct sampling intervals within a five year period are considered insufficient for impairment or attainment decisions.

Pathogen and microbial source assessment

When possible, microbial source tracking (MST) will be considered to distinguish the presence or absence of human sources. MST refers to a group of analytical protocols used to determine the source of fecal contamination and is applicable to both fresh and marine waters. These techniques attempt to determine whether fecal bacteria are being introduced into waterbodies through human, wildlife, or domestic animal sources. MST is based on the principles that some pathogens have an exclusive or preferential association with a particular host, and that these host-associated microorganisms are shed in fecal matter and can be detected in water bodies.⁸

Category Determination

Data is evaluated to determine whether a waterbody is attaining or impaired for the pathogens criteria by applying an impairment threshold that considers the magnitude, frequency and duration of exceedances. The magnitude is the numeric threshold (criteria), frequency is how often an exceedance can occur, and duration is the unit of measure (period of time).

Waterbodies⁹ are characterized as impaired (Category 5) when the data evaluation determines that the impairment threshold is exceeded and WQS are not met. If the data threshold is not exceeded, then the waterbody is considered to be attaining water quality standards (Category 2).

⁶ National Shellfish Sanitation Program (2019). <https://www.fda.gov/food/federalstate-food-programs/national-shellfish-sanitation-program-nssp>

⁷ This assumes that the 15 minimum samples in the first 90-day period was collected in one year.

⁸ Simpson et al 2002. Microbial Source Tracking: State of the Science. Environmental Science and Technology. 36: 5279-5288

⁹ Waterbody data is organized into assessment units (AU), or waterbody segments, for the purposes of evaluating data to determine compliance with water quality standards.

Table 4 summarizes the unit of measure, criteria, assessment period, minimum sample requirements and impairment thresholds for freshwater and marine designated uses. The criteria for all designated uses for pathogens are described in Tables 2 and 3.

For freshwater and marine water supply and recreation designated uses, DEC applies a geometric mean to data collected within a 30 day period and a 10% provision to all data collected each water year (Table 2). Each water year of sampling will be examined independently of other water years. For the marine harvesting for consumption of raw mollusks or other raw aquatic life use, DEC applies a geometric mean and a 10% provision to all data within a water year. Each water year of sampling will be examined independently.

A geometric mean tends to mitigate the effect of very high or low values which might bias an arithmetic mean. This approach is helpful when analyzing bacteria concentrations because levels may vary from 10 to 10,000-fold over a given period. It is appropriate to use non-detect samples to evaluate both the geometric mean and 10% portions of the criteria. Non-detect results will be calculated as 50% of the method detection limit.

In addition data evaluation results, DEC will consider additional factors if available, such as the results of a pathogen source assessment or sanitary survey, which indicate whether anthropogenic sources may be present; and/or the presence of overwhelming evidence.¹⁰ Collecting information on potential conditions that may have triggered exceedances (e.g., seasonal activities, flow conditions, temperature) is recommended, but not required to determine impairment.

Impairment thresholds for freshwater & marine water supply and contact recreation

A waterbody is considered impaired when there are exceedances of the 30-day geometric mean **or** more than 10% of samples exceed WQS in at least two out of five years. At least one 30-day sampling period per water year must demonstrate an exceedance of one or both parts of the criterion during both years of sampling.

If more than one 30-day sampling period is obtained within the same water year the data will be evaluated using a rolling 30-day geometric mean for the geometric mean portion of the standard; the 10% portion of the standard will apply to all data collected within the water year. An exceedance of both the 30-day geometric mean and the 10% provision in the same water year is considered to be a single exceedance. Both years considered must be within the most recent five year period (Table 4).

¹⁰ See DEC *Consolidated Assessment and Listing Methodology* (Revised 2021)

Table 4. Exceedance criteria for pathogens for freshwater and marine designated uses

Designated Use	Unit of Measure	Criteria	Assessment Period	Minimum # Samples	Impairment Threshold
Freshwater and Marine: Water Supply	Rolling 30-day geometric mean	20 fecal coliform cfu/100 ml	2 years within a 5 year period	5 samples per year	One exceedance of either unit of measure in each of 2 years
	10% of samples collected during water year	40 fecal coliform cfu/100 ml			
Freshwater: Contact Recreation	Rolling 30-day geometric mean	126 <i>E. coli</i> cfu/100 ml			
	10% of samples collected during water year	410 <i>E. coli</i> cfu/100 ml			
Marine: Contact Recreation	Rolling 30-day geometric mean	35 enterococci cfu/100 ml			
	10% of samples collected during water year	130 enterococci cfu/100 ml			
Marine Harvest: fecal coliform	Geometric mean of samples collected during one water year	14 fecal coliform cfu/100 ml	2 years within a 5 year period	15 samples in the first water year, 5 samples per water year in other years	One exceedance of either unit of measure in each of 2 water years
	10% of samples collected during water year	31 fecal coliform cfu/100 ml			

Impairment Threshold Statements

Fecal coliform for freshwater and marine water supply uses

- The individual sample result for fecal coliform (duration)
- may not exceed 40 cfu/100mL (magnitude)
- during more than 10% of the time per water year (frequency).

Or

- The 30-day geometric mean for fecal coliform (duration)
- may not exceed 20 cfu/100mL (magnitude)
- more than once in a two year period (frequency).

E. coli for freshwater contact recreation uses

- The individual sample result for *E. coli* (duration)
- may not exceed 410 cfu/100mL (magnitude)

- during more than 10% of the time per water year (frequency).
- Or**
- The 30-day geometric mean for *E. coli* (duration)
 - may not exceed 126 cfu/100mL (magnitude)
 - more than once in a two year period (frequency).

Enterococci for marine contact recreation use

- The individual sample result for enterococci (duration)
 - may not exceed 130 cfu/100mL (magnitude)
 - during more than 10% of the time per water year (frequency).
- Or**
- The 30-day geometric mean for enterococci (duration)
 - may not exceed 35 cfu/100mL (magnitude)
 - more than once in a two year period (frequency).

Impairment thresholds for marine water harvesting

A waterbody is considered impaired when there are exceedances of the geometric mean of the water year **or** more than 10% of samples exceed criteria provisions more than once in a two year period. An exceedance of both the geometric mean and the 10% provision in the same water year is considered to be a single exceedance. Each water year of sampling will be examined independently of other water years.

Impairment Threshold Statements

Fecal coliform for marine harvesting

- The individual sample result for fecal coliform (duration)
 - may not exceed 31 (cfu) per 100mL (magnitude)
 - during more than 10% of the time per water year (frequency).
- Or**
- The geometric mean for fecal coliform (duration)
 - may not exceed 14 cfu/100mL (magnitude)
 - more than once in a two year period (frequency).

Shellfish program assessment requirements

The DEC Environmental Health (EH) Shellfish Program manages the classification of growing waters and other actions associated with the commercial harvest of shellfish for consumption. Growing areas are classified based on guidelines established by the U.S. Food and Drug Administration and outlined in the National Shellfish Sanitation Program Guide for the Control of Molluscan Shellfish. For analysis, the number of samples per station depends on human habitation at the growing/harvesting area.

Minimum data requirements:

- Areas with no human habitation will require a total of 15 samples per station
- Areas with human habitation will require a total of 30 samples per station

Results from all sampling stations must demonstrate:

- a geometric mean not to exceed 14 fecal coliform cfu/100 ml
- and no more than 10% of the samples can have greater than 28 fecal coliform cfu/100ml

Sampling differences may exist between Division of Water and EH data collection cycles (water year versus calendar year) or criteria to make an administrative determination regarding the status of the water. In instances where the classification status of a shellfish growing area has been downgraded¹¹ by EH, factors affecting the distribution of pollutant sources have increased, or new sources have been identified, DEC may require additional data to demonstrate the status of water quality. Division of Water will consult with EH on water quality assessments that utilize EH datasets and potential impairment determinations to ensure consistency between respective program requirements.

Impairment Reclassification

DEC will reclassify a water from Category 5 to Category 2 when the most recent two years of data demonstrate attainment of water quality standards. The two years of data showing attainment must be within a five year period but need not be consecutive. Sampling should be designed to show that attainment is persistent.

¹¹ Classification status of potential commercial shellfish growing areas is done by means of a sanitary survey. Results of the survey are used to classify the waters into one of five categories. Downgrading the classification of a shellfish growing area is a function of several metrics such as shoreline surveys or bacteria samples, and can help recognize adverse pollution conditions.